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DOE-STD-XXXX-YR

DOE TECHNICAL STANDARD

Beryllium-Associated Worker Registry Data Collection and Management Guidance



U.S. Department of Energy
Washington, D.C. 20585

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FORWARD

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3. This standard was developed through a consensus process by staff operating the DOE Beryllium Worker Registry with expert review by data coordinators who report information to the registry. It was developed to facilitate the routine collection, analysis, and dissemination of information on the health effects of occupational exposure to beryllium.

CONTENTS

1. SCOPE	3
2. BACKGROUND	3
2.1. Data Sources.....	3
2.2. Site Registry Coordinator.....	4
2.3. Data Submission	4
2.4. Worker Confidentiality Protection.....	4
3. ROSTER OF BERYLLIUM ASSOCIATED WORKERS.....	5
4. BERYLLIUM-RELATED MEDICAL SURVEILLANCE	8
4.1. Beryllium Lymphocyte Proliferation Test (LPT) Results	8
4.2. Smoking Data.....	8
4.3. Chest X-Ray Results.....	9
4.4. Spirometry Results	9
4.5. DLCO Results	11
4.6. Referral/Follow-up	11
4.7. Bronchoalveolar Lavage (BAL) LPT Results	12
4.8. Transbronchial Biopsy and BAL Pathology Results.....	12
4.9. High-resolution Computed Tomography (CT) Results	13
4.10. Cardiopulmonary Exercise Testing (CPET) Results	13
4.11. CBD Evaluation Results.....	14
4.12. Beryllium Induced Dermatitis.....	15
5. DOE BERYLLIUM WORK HISTORY AND EXPOSURE DATA.....	15
5.1. Work History	16

5.2. Activities and Exposure	17
6. TABLE RELATIONSHIPS	21
7. REQUIRED FIELDS.....	21
8. QUALITY ASSURANCE	22
9. Appendix A – Frequently Asked Questions	23
10. Appendix B – Chronic Beryllium Disease Definition	26
11. Appendix C – Process-Operation-Task Examples.....	27
12. Appendix D –Limit of Quantitation	30
13. Appendix E --Calculating Non-standard Shift and Sequential Sample 8-Hour TWAs.	33

1. **SCOPE:** This standard provides acceptable methods for compliance with the requirements of Title 10 Code of Federal Regulations, Part 850.39 (10 CFR 850.39) “Recordkeeping and Use of Information.” It should be used by responsible employers subject to the requirements of 10 CFR 850 “Chronic Beryllium Disease Prevention Program” to guide their submission of information to the Department of Energy (DOE) Beryllium-Associated Worker Registry. Use of this standard promotes consistent reporting and efficient analysis and dissemination of information to those who need to know.
2. **BACKGROUND:** The DOE Beryllium-Associated Worker Registry is a complex-wide internal program to help DOE conduct and improve its environmental, safety and health programs regarding past, current, and future beryllium exposure and related health effects. Paragraph 10 CFR 850.39, specifies beryllium surveillance requirements for both DOE federal and contractor employees. The Registry assists DOE in understanding the effectiveness of efforts to reduce exposure to beryllium. It contains data on DOE contractor and federal workers and the jobs they performed while exposed to beryllium, results from screening tests for chronic beryllium disease, and the results from subsequent medical diagnostic procedures. Policy, guidelines and directives for the Registry are determined at DOE headquarters by the Office of Occupational Health (EH-53). The Registry is maintained by the Beryllium Registry Data Center at the Oak Ridge Institute for Science and Education (ORISE), Oak Ridge, Tennessee.

The Registry includes several components called *data sets*. These data sets include: a roster, or listing, of all current workers who are exposed to, or were previously exposed to beryllium, medical information related to signs and symptoms of beryllium related disease; work history of beryllium jobs while employed at a DOE site; and exposure data (industrial hygiene sampling data) with calculated 8-hour time-weighted average (TWA) for that exposure.

- 2.1. **Data Sources:** Sources of information for these data include human resource organizations; medical, safety, and industrial hygiene organizations; and other organizations such as operations, maintenance, engineering, and payroll. Additional sources of information may include Workers' Compensation files, the OSHA Form 200 log, and headquarters managed databases such as the Computerized Accident and Illness Reporting System (CAIRS), the Occurrence Reporting and Processing System (ORPS), and the Occurrence Reporting Binned Information Trending Tool (ORBITT).

In the event that a worker who is enrolled in the Registry dies, information regarding the cause of death should be entered into the Registry. This information is available from a death certificate, which may be available through the occupational medicine clinic or human resource departments. If a death certificate is not available, the cause of death information may sometimes be obtained from the medical record.

2.2. **Site Registry Coordinator:** A Registry coordinator must be identified at each DOE site to serve as the point of contact between the site and the Beryllium Registry Data Center at Oak Ridge. The Registry coordinator is responsible for coordinating activities at the site related to data collection, submitting data to the Data Center in a timely manner, receiving inquiries from the Data Center, contacting appropriate site personnel to resolve data management and collection issues, and correcting errors. It is expected that the Registry coordinator will interact with a variety of individuals at the site such as line managers, computer support personnel, industrial hygienists, and site medical clinic personnel.

2.3. **Data Submission:**

2.3.1. Each site should define the best file structure and transmitting protocol for their site, in coordination with the Beryllium Registry Data Center. All data *must* be submitted as electronic files. The Data Center is flexible as to file type and will work with each site individually to accommodate various computer systems.

2.3.2. All sites should have had, and been using, fully functioning data submission procedures no later than the 10 CFR 850 implementation date of January 7, 2002. Initial submissions to the Registry should have included all available data for all current beryllium-associated workers at that time.

2.3.3. Data must be submitted semi-annually to the Beryllium Registry Data Center at the Oak Ridge Institute for Science and Education (ORISE.) The reporting periods begin on January 1 and July 1. Data should be submitted within 30 days of the reporting period to:

The Beryllium Registry Data Center
ORISE Center for Epidemiologic Research
P.O. Box 117
Oak Ridge, TN 37831-0117

ORISE data coordinator: Phil Wallace
Phone: (865) 576-3142
Fax: (865) 576-9557
Email: wallacep@ornl.gov

2.4. **Worker Confidentiality Protection:** As indicated in the Beryllium Rule, the purpose of the Beryllium Registry is to help DOE in its mission to protect worker health. This can only be done if we know what factors place our workers at risk for developing sensitization or chronic beryllium disease so that these risks can be mitigated where possible. The Beryllium Registry contains de-identified data, that is, names, addresses, and other personal identifying information (such as social security numbers) are not included in the database. The data is not available for use in research studies where

investigators must identify individuals. Please note that the Beryllium Registry is explicitly exempt from Institutional Review Board review of research protocols under 10 CFR 745 section 101 (b)(4) that deals with Federal Policy for the Protection of Human Subjects, as the subjects cannot be identified, directly or through identifiers linked to subjects.

To maintain the confidentiality of Registry data, the Registry coordinator must insure that a unique, encrypted identification number is assigned to every worker included in the Registry. All information that is submitted to the Registry, regarding a specific worker, must include his or her unique encrypted identification number. As the health impact of beryllium exposure may not occur until many years after employment, the Registry coordinator must insure that a system is maintained that links a worker's identity to his or her unique identification number, even after the worker terminates employment.

Unique encrypted identifiers should not be overly simplistic, such as reversing the worker's social security number, and should not duplicate other existing identifiers. The unique identifier should not be re-assigned to a different worker, even if the first worker assigned to the identifier exits the workforce at that respective site. Should this worker return to the workforce at this site, his or her unique number should be restored to this specific individual. Sites that are participating in the Illness and Injury Surveillance Program (IISP) should use the previously assigned IISP identification number as the unique encrypted identifier.

When a worker transfers from one DOE site to another, he or she will be reassigned a new unique encrypted identifier, coded according to the current site's encryption scheme. Former sites should advise the transferees to identify themselves as a beryllium-associated worker to the site occupational medicine director (SOMD) upon their arrival at the new site. The SOMD should also determine if transferred workers were included in the Beryllium Registry at the previous site. If so, the SOMD will contact the SOMD at the previous site to obtain the old identification number so that linkages can be made.

To maintain the confidential nature of the Registry, 10 CFR 850.39 (e)(2)(i) requires that the SOMD, or other designated site personnel within the occupational medicine clinic retain the encryption key that identifies an individual worker to his or her unique identifier. Proper security, such as restricted access and locked files must be maintained.

3. **Roster Of Beryllium-Associated Workers:** The Roster Data Set is a compilation of all beryllium-associated workers. The Registry coordinator submits it to the Data Center. The roster must include all (DOE and contractor) workers who are defined as beryllium-associated workers by 10 CFR 850. Fields marked with an asterisk (*) are required.

Table 3. Roster

	Name	Description
1.	*Site Code	Site code (provided by ORISE Data Center)
2.	*Unique ID	Unique worker identification number (to be determined by site)
3.	*YearBorn	Year of birth
4.	*Gender	Gender of worker
5.	Race	If collected by the site
6.	*Employer Type	Indicate the worker's employer as (F)ederal, (C)ontractor, (S)ubcontractor, or (V)isitor
7. 7.	*First Hire on Site Date	Date first hired to work on current site
8.	Death Date	Date of death
9.	Immediate Cause	Text abstracted from death certificate, immediate cause
10.	First Cause	Text abstracted from death certificate, first "Due to or as a consequence of" section
11.	Second Cause	Text abstracted from death certificate, second "Due to or as a consequence of" section
12.	Other Cause	Other significant conditions contributing to the death
13.	*Old Unique ID	Unique ID from previous site, if applicable
14.	*Previous Site	Text field that contains the name of the previous site where the worker was employed as a beryllium worker.

- 3.1. **Site Code:** A unique code that identifies a site. The Beryllium Registry Data Center will provide a site code to each Registry coordinator. Sites currently participating in the IISP should use their current site codes.
- 3.2. **Unique ID:** This is an encrypted identification number unique to each beryllium-associated worker. It is assigned by the site and is used to link multiple records to one worker. Every record submitted to the Data Center must include the Unique ID. Sites enrolled in the IISP should use the workers' IISP identifiers as the Unique ID.

- 3.3. **Year Born:** Only the year of birth is requested in the Roster data set. This is a measure to help ensure privacy and prevent identification of individuals by using a specific date of birth.
- 3.4. **Gender:** Provide the code for the gender of the worker as either male or female.
- 3.5. **Race:** Provide race if captured by the site.
- 3.6. **Employer Type:** Indicate the worker's current employment type as federal, contractor, sub-contractor or visitor. Primary subcontractors to a site integrating contractor are considered a contractor for the Registry. Visitors include visiting scientists, graduate students, research collaborators, etc.
- 3.7. **First Hire on Site Date:** Provide the date that the worker was hired for the first time to work on the current DOE site (MM/DD/YYYY). Personnel records for current workers normally are transferred to successive contractors for a number of reasons and in particular in order to calculate employee benefits. Personnel departments should have this information. Medical records for current workers likewise are transferred to successive medical surveillance providers. The date of the worker's first medical examination should be in the current medical files and may be a reasonable surrogate for the date first hired to work on the current site if the true date is not available.
- 3.8. **Death Date:** Date on which worker's death occurred.
- 3.9. **Immediate Cause:** Text describing the immediate cause of death. Abstract "immediate cause of death" section from the death certificate.
- 3.10. **First Cause:** Text describing the first contributing cause of death. Abstract first "due to, or as a consequence of" section from the death certificate.
- 3.11. **Second Cause:** Text describing the second contributing cause of death. Abstract second "due to, or as a consequence of" section from the death certificate.
- 3.12. **Other Cause:** Text describing other significant conditions identified as contributing cause(s) of death, but not related to the immediate cause of death.
- 3.13. **Old Unique ID:** Unique ID from previous site (for workers who have transferred from one DOE site to another DOE site).
- 3.14. **Previous Site:** This is a text field that contains the name of the most previous site the worker was employed at as a beryllium-associated worker and was submitted to the Registry from that site. Examples of values: Sandia, LANL, Rocky Flats. (Site names can be abbreviated and will be changed to a code number by the Registry Data Center.)

4. **BERYLLIUM-RELATED MEDICAL SURVEILLANCE:** The beryllium-related medical surveillance data set contains the beryllium-related disease medical information obtained by the Site Occupational Medicine Director related to beryllium exposure and medical testing.

4.1. **Table 4.1 – Beryllium Lymphocyte Proliferation Test (LPT) Results**

1.	*Site Code	Site code (provided by ORISE Data Center)
2.	*Unique ID	Unique identifier (to be determined by the site)
3.	*LPT date	Date of blood draw for the LPT test
4.	*LPT result	LPT result: Normal (Negative), Abnormal (Positive), Refused, Borderline, Unsatisfactory

- 4.1.1. **Site Code:** A unique code that identifies a site. The Data Center will provide a site code to each data coordinator. Data coordinators currently participating in the IISP should continue to use their previously identified site codes.
- 4.1.2. **Unique ID:** This is an encrypted identification number unique to each beryllium-associated worker. It is assigned by the site and is used to link multiple records to one worker. Every record submitted to the Data Center must include the Unique ID. Sites enrolled in the IISP should use the workers' IISP identifiers as the Unique ID.
- 4.1.3. **LPT date:** Provide the date the blood was drawn for the LPT (MM/DD/YYYY).
- 4.1.4. **LPT result:** Provide the result of the LPT as Normal (Negative), Abnormal (Positive), Refused, Borderline (neither fully normal or fully abnormal), or Unsatisfactory (an unsatisfactory test). Note: lung function test results may be available even if the LPT is Normal or Negative.

4.2. **Table 4.2 – Smoking Data**

1.	*Site Code	Site code (provided by ORISE Data Center)
2.	*Unique ID	Unique identifier (to be determined by the site)
3.	Date reported	Date that data on smoking status was captured
4.	*SMOKE	Smoking status : Current (C) , Former (F), Never (N), Unknown (U)

4.2.1. **Site Code:** A unique code that identifies a site. The Data Center will provide a site code to each data coordinator. Data coordinators currently participating in the IISP should continue to use their previously identified site codes.

4.2.2. **Unique ID:** This is an encrypted identification number unique to each beryllium-associated worker. It is assigned by the site and is used to link multiple records to one worker. Every record submitted to the Data Center must include the Unique ID. Sites enrolled in the IISP should use the workers' IISP identifiers as the Unique ID.

4.2.3. **Date reported:** This is the date when the smoking status was captured

4.2.4. **SMOKE:** Indicate the worker's smoking status as: Current (C), Former (F), Never (N) , or if there are no data available, put Unknown (U).

4.3. Table 4.3 – Chest X-Ray Results

1.	*Site Code	Site code (provided by ORISE Data Center)
2.	*Unique ID	Unique identifier (to be determined by the site)
3.	Date CXR	Date chest X-ray
4.	CXR Result	Chest X-Ray results

4.3.1. **Site Code:** A unique code that identifies a site. The Data Center will provide a site code to each data coordinator. Data coordinators currently participating in the IISP should continue to use their previously identified site codes.

4.3.2. **Unique ID:** This is an encrypted identification number unique to each beryllium-associated worker. It is assigned by the site and is used to link multiple records to one worker. Every record submitted to the Data Center must include the Unique ID. Sites enrolled in the IISP should use the workers' IISP identifiers as the Unique ID.

4.3.3. **Date CXR:** Provide the date the chest X-Ray was taken (MM/DD/YYYY).

4.3.4. **CXR Result:** Indicate result of chest X-ray according to the ILO (International Labor Organization code), e.g. 0/0, or 0/1. If the X-ray does not have the ILO codes, the evaluation of the X-ray in text form is acceptable.

4.4. Table 4.4 – Spirometry Results

1.	*Site Code	Site code (provided by ORISE Data Center)
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2.	*Unique ID	Unique identifier (to be determined by the site)
3.	Spirometry Date	Date spirometry test administered
4.	FVC	Results of spirometry test – forced vital capacity
5.	FEV1	Results of spirometry test (forced expiratory volume) at 1.0 second
6.	FEV1/FVC	Results of spirometry test-a ratio
7.	FEV2575	Results of spirometry test between 25%-75% of forced expiratory volume

- 4.4.1. **Site Code:** A unique code that identifies a site. The Data Center will provide a site code to each data coordinator. Data coordinators currently participating in the IISP should continue to use their previously identified site codes.
- 4.4.2. **Unique ID:** This is an encrypted identification number unique to each beryllium-associated worker. It is assigned by the site and is used to link multiple records to one worker. Every record submitted to the Data Center must include the Unique ID. Sites enrolled in the IISP should use the workers' IISP identifiers as the Unique ID.
- 4.4.3. **Spirometry Date:** Date the spirometry test was administered (MM/DD/YYYY).
- 4.4.4. **FVC:** Spirometry result. FVC is “forced vital capacity” and is reported as percent of normal expected for a person of the worker’s size, age, and gender. Give value as a decimal, e.g. 0.75.
- 4.4.5. **FEV1:** Spirometry result. FEV_{1.0} is the “forced expiratory volume at 1.0 second” and is reported as percent of normal expected for a person of the worker’s size, age, and gender. Give value as a decimal.
- 4.4.6. **FEV1/FVC:** Results should be available with the FVC and FEV1 test results. This is typically reported as a decimal number.
- 4.4.7. **FEV2575:** Spirometry result. FEV₂₅₋₇₅ is the “forced expiratory volume between 25% and 75% of the total forced expiratory volume” and is reported as percent of normal expected for a person of the worker’s size, age, and gender. Give as a decimal.

4.4.8. **Table 4.5 – DLCO Results**

1.	*Site Code	Site code (provided by ORISE Data Center)
2.	*Unique ID	Unique identifier (to be determined by the site)
3.	DLCO Date	Date carbon monoxide diffusion test administered
4.	DLCO	Result of carbon monoxide diffusion test (DLCO)

4.4.9. **Site Code:** A unique code that identifies a site. The Data Center will provide a site code to each data coordinator. Data coordinators currently participating in the IISP should continue to use their previously identified site codes.

4.4.10. **Unique ID:** This is an encrypted identification number unique to each beryllium-associated worker. It is assigned by the site and is used to link multiple records to one worker. Every record submitted to the Data Center must include the Unique ID. Sites enrolled in the IISP should use the workers' IISP identifiers as the Unique ID.

4.4.11. **DLCO Date:** Date DLCO test was administered (MM/DD/YYYY).

4.4.12. **DLCO:** Results of carbon monoxide diffusion test that measures the ability of carbon monoxide to diffuse between lung cells and the blood stream. Given in percent carboxyhemoglobin saturation.

4.5. **Table 4.6 – Referral/Follow-up**

1.	*Site Code	Site code (provided by ORISE Data Center)
2.	*Unique ID	Unique identifier (to be determined by the site)
3.	Referral Offered Date	Date follow-up referral offered
4.	Follow-up Referral	Accepted (Y) or declined (N) referral for diagnostic follow-up

4.5.1. **Site Code:** A unique code that identifies a site. The Data Center will provide a site code to each data coordinator. Data coordinators currently participating in the IISP should continue to use their previously identified site codes.

4.5.2. **Unique ID:** This is an encrypted identification number unique to each beryllium-associated worker. It is assigned by the site and is used to link multiple records to one worker. Every record submitted to the Data Center must include the Unique ID. Sites enrolled in the IISP should use the workers' IISP identifiers as the Unique ID.

4.5.3. **Referral Offered Date:** Indicate date the follow-up referral was offered (MM/DD/YYYY).

4.5.4. **Follow-up Referral:** Indicate whether this individual accepted (Y) or declined (N) a referral for a follow-up examination.

4.6. **Table 4.7 – Bronchoaveolar Lavage (BAL) LPT Results**

1.	*Site Code	Site code (provided by ORISE Data Center)
2.	*Unique ID	Unique identifier (to be determined by the site)
3.	Date Lavage	Date of BAL
4.	Lavage Result	BAL results:

4.6.1. **Site Code:** A unique code that identifies a site. The Data Center will provide a site code to each data coordinator. Data coordinators currently participating in the IISP should continue to use their previously identified site codes.

4.6.2. **Unique ID:** This is an encrypted identification number unique to each beryllium-associated worker. It is assigned by the site and is used to link multiple records to one worker. Every record submitted to the Data Center must include the Unique ID. Sites enrolled in the IISP should use the workers' IISP identifiers as the Unique ID.

4.6.3. **Date Lavage:** Provide the date the BAL was administered (MM/DD/YYYY).

4.6.4. **Lavage Result:** Provide the result of the BAL LPT as Normal (Negative), Abnormal (Positive), Refused, Borderline (neither fully normal or fully abnormal), or Unsatisfactory (an unsatisfactory test). Note: pathology results may be available even if the LPT is Normal or Negative.

4.7. **Table 4.7 – Transbronchial Biopsy and BAL Pathology Results**

1.	*Site Code	Site code (provided by ORISE Data Center)
2.	*Unique ID	Unique identifier (to be determined by the site)
3.	Date BX	Date of transbronchial biopsy
4.	BX Result	Transbronchial biopsy result

4.7.1. **Site Code:** A unique code that identifies a site. The Data Center will provide a site code to each data coordinator. Data coordinators currently participating in the IISP should continue to use their previously identified site codes.

4.7.2. **Unique ID:** This is an encrypted identification number unique to each beryllium-associated worker. It is assigned by the site and is used to link

multiple records to one worker. Every record submitted to the Data Center must include the Unique ID. Sites enrolled in the IISP should use the workers' IISP identifiers as the Unique ID.

4.7.3. **Date BX:** Provide the date the transbronchial biopsy and BAL were administered (MM/DD/YYYY).

4.7.4. **BX Result:** Indicate results of pathologist's evaluation - suggested values are: normal (negative), positive- granuloma, positive-alveolitis, and positive- interstitial thickening. Indicate all that apply. Other values and comments may be provided.

4.8. Table 4.8 – High-resolution Computed Tomography (CT) Results

1.	*Site Code	Site code (provided by ORISE Data Center)
2.	*Unique ID	Unique identifier (to be determined by the site)
3.	Date CT	Date of CT studies
4.	CT Result	CT study result

4.8.1. **Site Code:** A unique code that identifies a site. The Data Center will provide a site code to each data coordinator. Data coordinators currently participating in the IISP should continue to use their previously identified site codes.

4.8.2. **Unique ID:** This is an encrypted identification number unique to each beryllium-associated worker. It is assigned by the site and is used to link multiple records to one worker. Every record submitted to the Data Center must include the Unique ID. Sites enrolled in the IISP should use the workers' IISP identifiers as the Unique ID.

4.8.3. **Date CT:** Provide the date the CT study was administered (MM/DD/YYYY).

4.8.4. **CT Result:** Indicate CT study result - suggested values are: normal, abnormalities consistent with CBD, opacities consistent with CBD, abnormalities requiring medical follow-up for conditions other than CBD, other values and comments may be provided.

4.9. Table 4.9 – Cardiopulmonary Exercise Testing (CPET) Results

1.	*Site Code	Site code (provided by ORISE Data Center)
2.	*Unique ID	Unique identifier (to be determined by the site)
3.	Date CPET	Date of CPET studies
4.	CPET Result	CPET study result

- 4.9.1. **Site Code:** A unique code that identifies a site. The Data Center will provide a site code to each data coordinator. Data coordinators currently participating in the IISP should continue to use their previously identified site codes.
- 4.9.2. **Unique ID:** This is an encrypted identification number unique to each beryllium-associated worker. It is assigned by the site and is used to link multiple records to one worker. Every record submitted to the Data Center must include the Unique ID. Sites enrolled in the IISP should use the workers' IISP identifiers as the Unique ID.
- 4.9.3. **Date CPET** Provide the date the CPET study was administered (MM/DD/YYYY).
- 4.9.4. **CPET Result:** Indicate CPET study result - These studies provide several measurements in the following categories. Suggested values would be normal or abnormal for: oxygen uptake, carbon dioxide output, gas exchange ratio, anaerobic threshold, cardiac output, blood pressure and vascular resistance, ventilation, and pulmonary gas exchange function.

4.10. Table 4.10 – CBD Evaluation Results

1.	*Site Code	Site code (provided by ORISE Data Center)
2.	*Unique ID	Unique identifier (to be determined by the site)
3.	CBD Date	Date CBD evaluation made
4.	CBD Result	CBD evaluation result

- 4.10.1. **Site Code:** A unique code that identifies a site. The Data Center will provide a site code to each data coordinator. Data coordinators currently participating in the IISP should continue to use their previously identified site codes.
- 4.10.2. **Unique ID:** This is an encrypted identification number unique to each beryllium-associated worker. It is assigned by the site and is used to link multiple records to one worker. Every record submitted to the Data Center must include the Unique ID. Sites enrolled in the IISP should use the workers' IISP identifiers as the Unique ID.
- 4.10.3. **CBD Date:** Indicate the date that the CBD evaluation was complete (MM/DD/YYYY).
- 4.10.4. **CBD Result:** Indicate CBD evaluation result as “Yes” or “No”, where “Yes” means the worker has a definitive diagnosis of CBD. Use the definition in use for the *Energy Employees Occupational Illness Compensation Program Act*, given in Appendix B. “No” may be inserted in this field but is not required to

show that the worker does not have CBD.

4.11. Table 4.11 – Beryllium Induced Dermatitis

1.	*Site Code	Site code (provided by ORISE Data Center)
2.	*Unique ID	Unique identifier (to be determined by the site)
3.	Date of Dermatitis	Date Be-induced dermatitis diagnosed
4.	Dermatitis Positive	Be-induced dermatitis diagnosed - Positive (P), Negative (N), Equivocal (E)

4.11.1. **Site Code:** A unique code that identifies a site. The Data Center will provide a site code to each data coordinator. Data coordinators currently participating in the IISP should continue to use their previously identified site codes.

4.11.2. **Unique ID:** This is an encrypted identification number unique to each beryllium-associated worker. It is assigned by the site and is used to link multiple records to one worker. Every record submitted to the Data Center must include the Unique ID. Sites enrolled in the IISP should use the workers' IISP identifiers as the Unique ID.

4.11.3. **Date Dermatitis:** Indicate the date of dermatitis diagnosis (MM/DD/YYYY).

4.11.4. **Dermatitis Positive:** Indicate whether beryllium induced dermatitis was diagnosed as: Positive (P), Negative (N), or if neither fully positive nor fully negative, put Equivocal (E).

5. **DOE BERYLLIUM WORK HISTORY AND EXPOSURE DATA:** The Beryllium Work History and Exposure Data Sets contain information about all activities having potential beryllium exposure where the beryllium-associated worker currently works or previously had worked and the exposures associated with those activities. The data should include working directly with beryllium, working in areas of potential beryllium exposure even if not working directly with beryllium, and activities with potential casual exposure to beryllium, such as working near an area where others are working directly with beryllium. Do not provide or submit classified data to the Registry.

5.1. Table 5.1 - DOE Beryllium Work History

	Name	Description
1	*Site Code	Site code (provided by ORISE Data Center)
2	*Unique ID	Unique employee identifier (provided by data coordinator)
3.	Organization Code	Department/division/organization
4.	First Beryllium Job Start Date	Date that first job involving beryllium began
5.	*Activity	General description of the job function
6.	*Job Title	Job title at time of Be exposure
7.	*Job Start Date	Date job involving beryllium began
8.	*Job Stop Date	Date job involving beryllium stopped

- 5.1.1. **SiteCode:** A unique code that identifies a site. The Data Center will provide a site code to each data coordinator. Data coordinators currently participating in the IISP should continue to use their previously identified site codes.
- 5.1.2. **Unique ID:** This is an encrypted identification number unique to each beryllium-associated worker. It is assigned by the site and is used to link multiple records to one worker. Every record submitted to the Data Center must include the Unique ID. Sites enrolled in the IISP should use the workers' IISP identifiers as the Unique ID.
- 5.1.3. **Organization Code:** Provide the worker's department, division, or organization code or number. The Registry coordinator must provide a data dictionary (the code and the organization associated with that code) to the Data Center.
- 5.1.4. **First Beryllium Job Start Date:** Provide the date the worker began working in the first job in which he or she was potentially or actually exposed to beryllium (MM/DD/YYYY). Medical records for current workers normally are transferred to successive medical surveillance providers. The date of the worker's first beryllium medical surveillance examination should be in the current medical files.
- 5.1.5. **Activity:** A high level roll-up category that is a general description of the job function. Select from one of the following categories.
- 5.1.5.1. Management (M) – Predominately office work at a desk; first level supervisor and above.

- 5.1.5.2. Administrative Support (A) – Predominately office-work at a desk but can include tasks that involve visiting, production areas, shops and labs. This category includes but is not limited to information technology, clerical, and secretarial staff.
- 5.1.5.3. In-House Professionals (I)– Predominately office work at a desk typically without supervisory responsibilities. Occasional tasks outside office create opportunities for exposure.
- 5.1.5.4. Field Professionals (F)– Frequently works outside of their office in areas such as but not limited to laboratories, testing areas, and construction areas.
- 5.1.5.5. Technical Support (T)– Workers who typically support the field professionals and have hands-on work situations.
- 5.1.5.6. Service (S)– Typically includes but is not limited to custodians, drivers, laborers, laundry workers, linemen, mail clerks, pilots, railroad engineers, records center workers, stationary engineers, utility workers, and water plant operators. These workers support and maintain the facility's infrastructure. Most work is not performed sitting at a desk.
- 5.1.5.7. Security and Fire (E) – Typically includes protective forces and firefighters.
- 5.1.5.8. Crafts (C) – Typically includes bargaining unit employees and laborers.
- 5.1.5.9. Line Operators (O)–Typically workers who are directly involved in process, operation, or line activities at the facility.
- 5.1.5.10. Guests (G) – Employees on short-term assignments or internships. Typically includes guest scientists, postdoctoral fellows, co-op students, and interns. Potential for exposure dependent on job assignment.
- 5.1.5.11. Unknown (U) – Job title is missing.
- 5.1.6. **Job Title:** Provide the worker's job title at time of exposure, (e.g. Machinist, QA Laboratory Technician, Chemical Operator).
- 5.1.7. **Job Start Date:** Provide the date the worker began working in the job in which he or she was potentially or actually exposed to beryllium (MM/DD/YYYY).
- 5.1.8. **Job Stop Date:** Provide the date the worker stopped working in the job in which he or she was actually or potentially exposed to beryllium (MM/DD/YYYY).

5.2. Table 5.2 DOE Beryllium Activities and Exposure

	Name	Description
1.	*Site Code	Site code (provided by ORISE Data Center)
2.	*Unique ID	Unique employee identifier (provided by data coordinator)
3.	*Location Identification	Location where the exposure occurred
4.	*Room/Area	Room/area where exposure occurred
5.	*Process	Free form text describing beryllium activity process
6.	*Operation	Free form text describing the beryllium activity operation
7.	*Task	Free form text describing the beryllium activity task
8.	*Actual Exposure	Actual exposure level or limit of quantitation during the sampling period in $\mu\text{g}/\text{m}^3$
9.	*Actual Exposure<LOQ	Indicate whether the actual exposure is less than the limit of quantitation, Y/N.
10.	*Exposure Sample Volume	The volume of air sampled in liters.
11.	*8-hour TWA	8-hour time weighted average exposure level or limit of quantitation in $\mu\text{g}/\text{m}^3$
12.	Exposure Method	Free form text describing the type of exposure method
13.	Sampling Method	Describe the sampling method used
14.	Analytic Method	Describe the analytic method used
15.	*Exposure Sampling Time	Exposure sampling time (min.)
16.	Sample Number	Sample identification number
17.	*Monitoring Date	Date monitoring was conducted - MM/DD/YYYY
18.	Chemical	Free form text describing beryllium chemical compound
19.	Engineering Controls	Free form text describing engineering controls
20.	PPC&E	Personal protective clothing and equipment used? Y/N
21.	*Respirator Protection	Respiratory protection used? Y/N
22.	*Respirator APF	Respiratory protection “Assigned Protection Factor “

5.2.1. **Site Code:** A unique code that identifies a site. The Data Center will provide a site code to each data coordinator. Data coordinators currently participating in the Epidemiologic Surveillance Program should continue to use their previously identified site codes.

5.2.2. **Unique ID:** This is an encrypted identification number unique to each beryllium-associated worker. It is assigned by the site and is used to link multiple records to one worker. Every record submitted to the Data Center must include the Unique ID. Sites enrolled in the IISP should use the workers' IISP identifiers as the Unique ID.

- 5.2.3. **Location Identification:** Provide the on-site code for the location within which the beryllium exposure occurred. This is the unique administrative code that usually is established by the facility or property management organization for each building and area on site. The Registry coordinator must provide a data dictionary (the code and the building or area associated with that code) to the Data Center. This cannot be null, nor can it be populated with “not available”.
- 5.2.4. **Room/area:** Provide the room number or other identifier of the area where the beryllium exposure occurred. This cannot be null, nor can it be populated with “not available”.
- 5.2.5. **Process:** Free form text that describes the beryllium activity process. Process is the highest level of grouped tasks. Dry machining is an example of a process. See Appendix C for more examples.
- 5.2.6. **Operation:** Free form text that describes the beryllium activity operation. Operation is the mid-level of grouped tasks. Using a particular type of lathe is an example of an operation in the dry machining process. See Appendix C for more examples.
- 5.2.7. **Task:** Free form text that describes the beryllium activity task. Task is the lowest level of beryllium activity and is not grouped. Machine preparation is an example of a task performed in the operation of using a particular type of lathe. See Appendix C for more examples.
- 5.2.8. **Actual Exposure:** Provide the actual level of the worker's beryllium exposure during the sampling period for the Task (field 7) as determined by personal monitoring of the worker or by some other method. Examples of other methods are use of direct-reading instruments, field wet chemical analysis results, and presuming an exposure based on the monitoring results of other workers performing similar tasks. The industrial hygienist must calculate the actual exposure before submitting data to the site Registry coordinator. The exposure level should be reported as the limit of quantitation if the monitoring result does not exceed that level (e.g., 0.01 µg/m³). See Appendix D for an explanation of limit of quantitation.
- 5.2.9. **Actual Exposure <LOQ:** Indicate by Y/N whether the value reported in Actual Exposure (field 8) is the actual exposure limit of quantitation rather than the actual measured exposure level. "Yes" indicates that the value reported in field 8 is the actual exposure limit of quantitation.

- 5.2.10. **Exposure Sample Volume:** This is the volume of air sampled, in liters, that was used to calculate the "Actual Exposure" above.
- 5.2.11. **8-hour TWA:** Provide the 8-hour TWA (time weighted average) of the worker's beryllium exposure for the work shift as determined by personal monitoring of the worker or other method. The industrial hygienist must calculate the 8-hour TWA before submitting the data to the Registry coordinator. If monitoring results show levels of beryllium that are less than the limit of quantitation, the 8-hour TWA should be calculated using the limit of quantitation (e.g., 0.03 µg/m³). See Appendix D for an explanation of limit of quantitation. See Appendix E for calculating 8-hour TWAs for non-standard work shifts and sequential sample results including results that are LOQ.
- 5.2.12. **Exposure Method:** Free form text describing the type of exposure measuring method used. Personal breathing zone is most common. Examples of other methods are use of direct-reading instruments, field wet chemical analysis results, and presuming an exposure based on the monitoring results of other workers performing similar tasks.
- 5.2.13. **Sampling Method:** Describe the sampling method used. Examples are procedures in the U.S. Department of Labor, Occupational Safety and Health Administration, OSHA Technical Manual, Fourth Edition, OSHA Instruction TED 1-0.15A, Washington, D.C., Government Institute, Inc., 1-20-99; National Institute for Occupational Safety and Health, Analytical Method 7102, Issue 1, 2-15-84; and National Institute for Occupational Safety and Health, Analytical Method 7300, Issue 2, 8-15-94.
- 5.2.14. **Analytic Method:** Describe the analytic method used. Examples are procedures in the U.S. Department of Labor, Occupational Safety and Health Administration, OSHA Technical Manual, Fourth Edition, OSHA Instruction TED 1-0.15A, Washington, D.C., Government Institute, Inc., 1-20-99; National Institute for Occupational Safety and Health, Analytical Method 7102, Issue 1, 2-15-84; and National Institute for Occupational Safety and Health, Analytical Method 7300, Issue 2, 8-15-94.
- 5.2.15. **Exposure Sampling Time:** The length of time of the sampling that generated the actual sample exposure level, Actual Exposure (field 8), or an analogous length of time if possible, if the exposure was presumed by some other method. Examples of other methods are use of direct-reading instruments, field wet chemical analysis results, and presuming an exposure based on the monitoring results of other workers performing similar tasks.

- 5.2.16. **Sample Number:** Identifying number assigned to the sample that generated Actual Exposure (field 8) for tracking purposes. Sites must ensure that the sample number does not identify the employee. Sites may use encrypted numbers.
- 5.2.17. **Monitoring Date:** The date on which the monitoring was conducted that generated the actual exposure level used in calculating the 8hrTWA. Use the date of the first day if the monitoring spans midnight.
- 5.2.18. **Chemical:** Free form text that identifies the chemical composition of the beryllium being monitored.
- 5.2.19. **Engineering Controls:** Free form text used to indicate type of engineering controls used with the Task (field 7).
- 5.2.20. **PPC&E:** Indicate whether personal protective clothing and equipment was used with the Task (field 7).
- 5.2.21. **Respirator Protection:** Indicate whether respiratory protection was used with the Task (field 7).
- 5.2.22. **Respirator APF:** Provide the Assigned Protection Factor for respiratory protection when it was used for the Task (field 7).
6. **TABLE RELATIONSHIPS:** All tables can be related to one another by concatenating the Site Code and Unique ID as a key. This will allow any records in any tables to be related to any other table. However, there are some logical relationships that also exist. The Roster table is the driving source of the Registry. All medical surveillance, work history, and exposure/sampling data must match to a Roster table record via the Site Code/Unique ID key. If not, these records will be questioned and returned to the site for resolution.
- The Medical Surveillance table is not related logically to the Work History or Activities and Exposure table, and there can be a many-to-one relationship from the medical surveillance table to the roster.
- The Work History table is related logically to the roster only by the Job Stop Date and the Date Employment Ended. A worker cannot have a Job Stop Date that is later than a Date Employment ended (i.e., they cannot be working on a job later than their employment existed). The Activities and Exposure table relates logically to the Work History table in a many-to-one fashion by checking the Monitoring Date field with the time window of the job start and stop dates.
7. **REQUIRED FIELDS:** Every record must contain the worker's Unique ID and Site Code. This allows all the records on an individual worker to be linked. In addition to the Unique ID

and Site Code, selected fields in all the data sets must be populated every time data is submitted. These fields are indicated by * in the tables.

8. **QUALITY ASSURANCE:** The Data Center performs edit and logic checks on the data as part of its quality assurance procedures. The integrity of the Activities and Exposure Data Set is achieved by maintaining the chronological order of a worker's job history. For example, if a record is submitted with a stop date for a beryllium activity, there must be a prior record with an activity start date.

The unique identification number of a record submitted for the medical surveillance, work history and exposure data sets must match a unique identification number of a record in the Roster data set. The Data Center will prepare a list of edit checks and furnish these to the data coordinator so that inconsistencies and errors can be resolved.

Appendix A – Frequently Asked Questions

General Questions

Q. – Where do I get the site code?

A. – That is a number that is furnished to you by the Registry Data Center

Q. - Will others be able to request and receive data I have submitted from my site?

A. - No. Obtaining a copy of data that was submitted from other sites requires DOE approval.

Q. – Can I get a copy of the list where numbers are assigned to each site?

A. – No. As an extra step to help protect the identity and confidentiality of the workers, this list will be maintained at the Registry Data Center and will not be give to anyone else.

Q. – Are self-identified beryllium workers to be included in the Registry?

A. – Yes.

Q. – Do I have to submit a value for all required fields?

A. – Yes. If a required field contains a null it will be flagged as an error and returned to the site for resolution.

Roster Questions

Q. – After the initial the roster was submitted by January, 2002, do we submit all the roster records again every six months with the changes incorporated?

A. – No. After the initial roster was submitted by January, 2002, all of those workers will be in the roster forever and there is no need to submit them again unless they (1) have some piece of data in error that you have detected and wish to correct, (2) terminate/retire, or (3) expire.

Q. – When submitting the roster for the first time, the “Date Employment Ended” field is required, but the roster is for current workers only, so how is this field populated?

A. – This field is blank (null) when the roster is submitted for the first time. As workers exit from the workforce, “change” records will be submitted to update this field for the affected worker.

Q. - At our site, it is common for an employee to jump from one employer to another. Do I fill out a roster record each time this occurs.

A. - If this is an employee that you as a site are responsible for reporting into the Registry, then the answer is “YES”.

Q. - We seldom get death certificates or any death information. What do we supply when we know the person has deceased?

A. - Every effort should be made to get these data but if they are not obtainable, it is advisable to put “N/A” in the field and that will give the Registry an indication the person is deceased but the data are not available.

A - Suppose an employee terminates from our company. How do I submit this to the registry?

Q. - In the next submission, include the roster record for this person with all of the data fields populated as you need them to be. Upon receipt, the roster table will be scanned for this person and the newest submitted record will replace the existing one.

Medical Surveillance Questions

Q. - If I have submitted a record for an LPT and discovered that the date in that record for that LPT is wrong, how do I correct it?

A. - We have observed there are very few “deletes” requested for entire records, which is one reason for doing away with the “status” field of “new”, “change”, or “delete”. To accomplish the desired action stated above, the site needs to do (1) call or email the Data Center and inform us to delete the existing record and replace it with this newest submitted record, or (2) just submit the correct version and we’ll assume that it is a replacement by matching on ID and date. This holds true for all other tables in the Medical Surveillance group.

Q. - Sometimes a person has the option of taking a chest X-ray and spirometry even if the LPT is normal. Do we submit these values anyway?

A. - Yes. Submit any test results requested by the Registry that the person may have, regardless of the LPT result.

Work History

Q. - Due to security reasons, the job title cannot be provided. Is it acceptable to leave it blank?

A. - It is required to have some value here, so a generalization is recommended so the field is not blank. This will give some indication of what the person was doing to become identified as a beryllium-associated worker.

Q. – The “Job Stop Date” is a required field but if these are current workers, when should I leave this field blank (null) and when should I populate it?

A. – If the worker is currently employed and is currently in the job that identified him/her as a beryllium-associated worker, then this field is left blank (null), thus indicating the person still performs this job. However, some sites have indicated that they plan to go back in their archives and retrieve some older data (i.e., prior to January 7, 2002) and will submit that to the Registry. The Registry staff is looking forward to this because the more of these data that can be collected, the more robust the Registry will be. For these retrospective records, this field will be populated as these workers quit these jobs that qualified them as beryllium-associated or were moved to other jobs.

Q. – Are sites required to retrieve retrospective work history data for beryllium workers?

A. – According to the rule, the answer is no, although these data would increase the value of the Registry and some sites have said they can do this easily and will do so.

Activities and Exposure Table

Q. – Again, security concerns arise with combining data from the DOE Activities and Exposure table, particularly the fields Process, Operation, and Task. What should a site do in this case?

A. - Generalizations are recommended for the values in these fields that allow the Registry to have data that are as detailed and complete as possible without breaching security restrictions. Each site has to assess their own situation and develop a data policy/procedure they are comfortable with, ensuring that security is not compromised.

Q. – The Sample Number field can be traced to an individual. To protect confidentiality, what should a site do?

A. – Notice that this field is not required, but some sites asked/recommended that it be included to make it easier to search samples for specific values or to answer questions that may arise from these data. Most sites have procedures to maintain confidentiality of sampled individuals. If a site needs to use some form of encryption, that is acceptable. This field is there primarily for the site’s use.

Q. – Is there a limit to the amount of text that can be supplied for the Process field?

A. – No, the field is virtually limitless.

Appendix B – Chronic Beryllium Disease Definition

The following definition of chronic beryllium disease is taken from the *Energy Employees Occupational Illness Compensation Program Act Of 2000, As Amended*, 42 U.S.C. § 7384 *et seq.*

The Act uses the term “established chronic beryllium disease” and defines chronic beryllium disease in the definition of that term.

Direct quote from the Act:

PART B—PROGRAM ADMINISTRATION

§ 7384l. Definitions for program administration

(13)The term "established chronic beryllium disease" means chronic beryllium disease as established by the following:

(A) For diagnoses on or after January 1, 1993, beryllium sensitivity (as established in accordance with paragraph (8)(A)), together with lung pathology consistent with chronic beryllium disease, including—

(i) a lung biopsy showing granulomas or a lymphocytic process consistent with chronic beryllium disease;

(ii) a computerized axial tomography scan showing changes consistent with chronic beryllium disease; or

(iii) pulmonary function or exercise testing showing pulmonary deficits consistent with chronic beryllium disease.

(8)(A) Beryllium sensitivity as established by an abnormal beryllium lymphocyte proliferation test performed on either blood or lung lavage cells.

Appendix C – Process-Operation-Task Examples

PROCESS	OPERATION	TASK
DRY MACHINING	HARDINGE LATHE	MACHINE PREP
DRY MACHINING	HARDINGE LATHE	OPERATING LATHE
DRY MACHINING	HARDINGE LATHE	CLEAN UP
DRY MACHINING	HARDINGE LATHE	MAINTAIN EQUIPMENT
DRY MACHINING	BRIDGEPORT MILL	MACHINE PREP
DRY MACHINING	BRIDGEPORT MILL	OPERATING MILL
DRY MACHINING	BRIDGEPORT MILL	CLEAN UP
DRY MACHINING	BRIDGEPORT MILL	MAINTAIN EQUIPMENT
POWDER OPERATIONS	BERYLLIUM PLASMA SPRAYING	POWDER/CHAMBER INSPECTION
POWDER OPERATIONS	BERYLLIUM PLASMA SPRAYING	ATTACH/REMOVE CANISTERS
POWDER OPERATIONS	BERYLLIUM PLASMA SPRAYING	LOAD SAMPLE
POWDER OPERATIONS	BERYLLIUM PLASMA SPRAYING	SPRAY OPERATION
POWDER OPERATIONS	BERYLLIUM PLASMA SPRAYING	BLOW DOWN
POWDER OPERATIONS	BERYLLIUM PLASMA SPRAYING	PART TRANSFER
ANALYSIS	ICP BERYLLIUM ANALYSIS	PREP STANDARDS
ANALYSIS	ICP BERYLLIUM ANALYSIS	INSTRUMENT ANALYSIS
ANALYSIS	ICP BERYLLIUM ANALYSIS	SAMPLE RECEIVING AND PREPARATION
ANALYSIS	ICP BERYLLIUM ANALYSIS	DATA MANAGEMENT AND REPORTS
ANALYSIS	ICP BERYLLIUM ANALYSIS	WASHING GLASSWARE AND GENERAL HOUSEKEEPING
ANALYSIS	ICP BERYLLIUM ANALYSIS	CHEMICAL STORAGE AND WASTE MANAGEMENT
POWDER OPERATIONS	BERYLLIUM PLASMA SPRAY OPERATIONS	VACUUM PUMP MAINTENANCE
POWDER OPERATIONS	BERYLLIUM PLASMA SPRAY OPERATIONS	TORCH MANIPULATOR MAINTENANCE
ES&H SUPPORT	SAMPLE COLLECTION	TAKE AIR SAMPLES
ES&H SUPPORT	SAMPLE COLLECTION	TAKE SWIPE SAMPLES
ES&H SUPPORT	SAMPLE COLLECTION	TAKE VACUUM/BULK SAMPLES
ES&H SUPPORT	INSPECTION, EVALUATION, AND INVESTIGATION	VERIFY ADMINISTRATIVE CONTROLS
ES&H SUPPORT	INSPECTION, EVALUATION, AND INVESTIGATION	PERFORM GENERAL WALKTHROUGHS
ES&H SUPPORT	INSPECTION, EVALUATION, AND INVESTIGATION	PERFORM PHYSICAL HAZARD EVALUATIONS
ES&H SUPPORT	INSPECTION, EVALUATION, AND INVESTIGATION	EVALUATE ENGINEERING CONTROLS
ES&H SUPPORT	INSPECTION, EVALUATION, AND INVESTIGATION	EVALUATE CHEMICAL HAZARDS
ES&H SUPPORT	EQUIPMENT MAINTENANCE	CLEANING AND PACKAGING
ES&H SUPPORT	EQUIPMENT MAINTENANCE	CALIBRATING, ADJUSTING, AND TROUBLESHOOTING
ES&H SUPPORT	SHORT-TERM HCP OPERATIONS	SUPPORTING A LOW RESIDUAL RISK OPERATION
ES&H SUPPORT	SHORT-TERM HCP OPERATIONS	SUPPORTING A MINIMAL RESIDUAL RISK OPERATION
ES&H SUPPORT	SHORT-TERM HCP OPERATIONS	SUPPORTING A MEDIUM RESIDUAL RISK OPERATION

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CUSTODIAL/JANITORIAL	EQUIPMENT DECON	WET WIPING
CUSTODIAL/JANITORIAL	EQUIPMENT DECON	STRIPCOAT REMOVE
CUSTODIAL/JANITORIAL	EQUIPMENT DECON	HEPA FILTERED VACUUMING
CUSTODIAL/JANITORIAL	GENERAL DECON	WET MOPPING
CUSTODIAL/JANITORIAL	GENERAL DECON	STRIPCOAT REMOVE
CUSTODIAL/JANITORIAL	GENERAL DECON	HEPA FILTERED VACUUMING
DECONTAMINATION	GENERAL DECON	APPLYING STRIPCOAT
DECONTAMINATION	GENERAL DECON	SETTING UP/TEARING DOWN
DECONTAMINATION	GENERAL DECON	REMOVING STRIPCOAT
DECONTAMINATION	GENERAL DECON	WET MOPPING
DECONTAMINATION	GENERAL DECON	WET WIPING
DECONTAMINATION	GENERAL DECON	HEPA FILTERED VACUUMING
DECONTAMINATION	EQUIPMENT DECON	SETTING UP / TEARING DOWN
DECONTAMINATION	EQUIPMENT DECON	APPLYING STRIPCOAT
DECONTAMINATION	EQUIPMENT DECON	REMOVING STRIPCOAT
DECONTAMINATION	EQUIPMENT DECON	WET MOPPING
DECONTAMINATION	EQUIPMENT DECON	WET WIPING
DECONTAMINATION	EQUIPMENT DECON	HEPA FILTERED VACUUMING
DECONTAMINATION	LAUNDRY	COLLECTING LAUNDRY
DECONTAMINATION	LAUNDRY	WASHING/DRYING LAUNDRY
DECONTAMINATION	LAUNDRY	FOLDING/STORING LAUNDRY
DECONTAMINATION	HEPA VACUUM MAINTENANCE	CHANGE PAPERBAG, MAIN & MICRO FILTERS
DECONTAMINATION	HEPA VACUUM MAINTENANCE	CHANGE ULPA/HEPA FILTERS
DECONTAMINATION	DRYER LINT COLLECTOR	REMOVING LINT
DECONTAMINATION	DRYER LINT COLLECTOR	CHANGING LINT BAG
DECONTAMINATION	OVERHEAD DECON	WET WIPING
DECONTAMINATION	OVERHEAD DECON	HEPA FILTERED VACUUMING
GLOVEBOX MAINTENANCE	INSPECTION	TRANSFER GLOVEBOX INSPECTION
GLOVEBOX MAINTENANCE	INSPECTION	PLASMA SPRAY CHAMBER GLOVEBOX INSPECTION
GLOVEBOX MAINTENANCE	GLOVE CHANGE	TRANSFER GLOVEBOX GLOVE CHANGE
GLOVEBOX MAINTENANCE	GLOVE CHANGE	PLASMA SPRAY CHAMBER GLOVEBOX GLOVE CHANGE
POWDER OPERATIONS	BERYLLIUM PLASMA SPRAY MAINTENANCE	TORCH MAINTENANCE
POWDER OPERATIONS	BERYLLIUM PLASMA SPRAY MAINTENANCE	VACUUM PUMP MAINTENANCE
POWDER OPERATIONS	BERYLLIUM PLASMA SPRAY MAINTENANCE	POWDER HOPPER MAINTENANCE
POWDER OPERATIONS	GLOVEBOX MAINTENANCE	INSPECTION
POWDER OPERATIONS	GLOVEBOX MAINTENANCE	GLOVE CHANGE
PARTICULATE CONTAINER HANDLING	CYCLONE CONTAINER CHANGE-OUT	REMOVING/INSTALLING CONTAINER
PARTICULATE CONTAINER HANDLING	CYCLONE CONTAINER CHANGE-OUT	POST OPERATION CLEAN-UP
PARTICULATE CONTAINER HANDLING	DUST COLLECTOR CANISTER CHANGE-OUT	REMOVING/INSTALLING CONTAINER
PARTICULATE CONTAINER HANDLING	DUST COLLECTOR CANISTER CHANGE-OUT	POST OPERATION CLEAN-UP

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FACILITY OPERATIONAL SUPPORT	SHORT TERM HCP	RESIDUAL RISK MEDIUM
FACILITY OPERATIONAL SUPPORT	SHORT TERM HCP	RESIDUAL RISK LOW
FACILITY OPERATIONAL SUPPORT	SHORT TERM HCP	RESIDUAL RISK MINIMAL
FACILITY OPERATIONAL SUPPORT	ROUTINE MAINTENANCE	
FACILITY OPERATIONAL SUPPORT	ROUTINE INSPECTION	INSPECTING SAFETY SHOWERS & EYEWASH
FACILITY OPERATIONAL SUPPORT	ROUTINE INSPECTION	INSPECTING FIRE EXTINGUISHERS
FACILITY OPERATIONAL SUPPORT	ROUTINE INSPECTION	INSPECTING EMERGENCY LIGHTING
FACILITY OPERATIONAL SUPPORT	ROUTINE INSPECTION	INSPECTING COMBUSTIBLE LOADING
ENVIRONMENTAL SAMPLING	BERYLLIUM PRECISION MACHINE SHOP	EDM MACHINING
FACILITY OPERATIONAL SUPPORT	ROUTINE SURVEILLANCE & CALIBRATION	SURVEYING HVAC SYSTEM PID/PDIP
FACILITY OPERATIONAL SUPPORT	ROUTINE SURVEILLANCE & CALIBRATION	SURVEYING LOCAL VENTILATION ALARMS
ELECTRICAL SERVICE/INSTALLATION/REPAIR	SERVICE	
ELECTRICAL SERVICE/INSTALLATION/REPAIR	INSTALL	
ELECTRICAL SERVICE/INSTALLATION/REPAIR	REPAIR	
ELECTRICAL SERVICE/INSTALLATION/REPAIR	SCOPE WORK TICKET	
CONSTRUCTION/MAINTENANCE OPERATIONS	GENERAL MAINTENANCE	
WELDING	PIGMA WELDING	
WELDING	LEAK CHECK	
WELDING	RESTRAINED BEND	
WELDING	MAINTENANCE	

Appendix D –Limit of Quantitation

The limit of quantitation (LOQ) is defined as the lowest concentration that can be reported reliably, that is, with a high degree of statistical certainty (*Quality Assurance Manual for Industrial Hygiene Chemistry*, American Industrial Hygiene Association, Sampling and Laboratory Analysis Committee, 1995, pages 36-38). The U. S. Environmental Protection Agency (EPA) *SW-846 Manual* refers to this as the Estimated Quantitation Limit (EQL) and defines it as “the lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions.” The term “LOQ,” rather than “EQL,” is used for the balance of this discussion.

Note that the LOQ is determined by the analytical laboratory. It is the product of the laboratory’s Limit of Detection (LOD) and estimate of uncertainty of measurements.

A definition of the LOD, also known as the Method Detection Limit (MDL), is found in the U.S. Environmental Protection Agency, *40 CFR Part 136, Appendix B, Definition and Procedure for the Determination of the Method Detection Limit*. “The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.” The term “LOD,” rather than “MDL,” is used for the balance of this discussion. Examples of determining the LOD can be found in Chapter One “Quality Control” of the EPA *SW-846 Manual*, and in the International Union of Pure and Applied Chemistry *Compendium of Analytical Nomenclature, Definitive Rules*, Third Edition.

The laboratory’s estimate of uncertainty is determined by combining the uncertainties inherent in measurements such as using balances for mass, using dispensers for volumes, the effect of temperature variations on instrument readings, etc. by accepted methods such as those found in the EURACHEM/CITAC *Guide, Quantifying Uncertainty in Analytical Measurement*, Second Edition; Editors: S.L.R.Ellison, M Rosslein, and A. Williams. The LOQ is generally found to be 5 to 10 times the LOD, and is highly matrix-dependent (see *SW-846*, Chapter One “Quality Control”).

Many laboratories report to their clients a LOQ that is higher than the numbers they determine by their procedures because many clients would rather have a higher, but constant, LOQ than have a LOQ that is lower but often changes after the laboratory conducts their routine quality assurance procedures. These laboratories report a LOQ that they are confident that they can consistently achieve.

An illustration of how LOQ and LOD are used:

A laboratory digests a set of beryllium samples and brings the digested samples volumes up to 25 mL for analysis by Inductively Coupled Plasma Spectroscopy (ICP). It conducts a LOD procedure on the samples and determines its LOD to be 0.155 µg/L.

It calculates a LOD of $0.155 \text{ µg/L} \times 0.025 \text{ L/sample} = 0.004 \text{ µg/sample}$. The LOD of the beryllium in a sample therefore is 0.004 µg.

To obtain the LOQ, the laboratory conducts an estimation of uncertainty procedure and determines its combined uncertainty to be 7.0. This includes the uncertainties inherent in analyzing this specific sample matrix.

It calculates a LOQ of $0.004 \text{ µg/sample} \times 7.0 = 0.028 \text{ µg/sample}$. The LOQ of the beryllium in a sample therefore is 0.028 µg for the specified sample matrix.

Industrial hygienists typically submit sample volumes along with air samples to laboratories for analysis and the laboratories return results in concentrations. The laboratories divide the mass of beryllium in the sample by the sample volume to calculate the concentration of beryllium in air.

When sample results are below the LOQ but above the LOD, laboratories typically report a result of “Less Than (LOQ value)”. For instance, referring to the above example, such a result might be reported as “Less Than 0.028 µg” for the sample. In the case of air samples collected on a filter medium, laboratories would typically divide their LOQ by the sample volume to calculate a concentration result. For instance, if the sample volume is 1,000 liters (or 1 m³), the result reported to the Registry would be “Less Than 0.028 µg/m³.” THIS CONCENTRATION VALUE IS THE VALUE REQUIRED BY THE REGISTRY (TABLE 4, FIELD 9) WHEN A RESULT IS LESS THAN THE LOQ.

Laboratories avoid reporting numbers for results between their LOD and LOQ because recipients often ascribe meaning to those numbers that is not technically valid. However, most laboratories will provide those numbers if the client insists and will flag the values to indicate that they are below the LOQ. For example, a laboratory might report a result of 0.014 µg for the sample or 0.014 µg/m³ for a 1 m³ volume sample and flag it as “Less Than the LOQ, LOQ = 0.028 µg” or “Less Than the LOQ, LOQ = 0.028 µg/m³.” NOTE THAT THE REGISTRY REQUIRES THE LOQ, NOT A NUMBER BETWEEN THE LOD AND LOQ.

Laboratories typically characterize results as “Non-detect” for samples for which the beryllium mass result is less than the laboratory’s LOD. They avoid providing numbers for those results because recipients often ascribe meaning to those numbers that is not technically valid. However, most laboratories will provide those numbers if the client insists and will flag the values to indicate that they are below the LOD. For example, a laboratory might report a number such as 0.002 µg for the sample or 0.002 µg/m³ for a 1 m³ volume sample and flag it as “Less Than the LOD, LOD = 0.004 µg” or “Less Than the LOD, LOD = 0.004 µg/m³.” NOTE THAT

THE REGISTRY REQUIRES THE LOQ, NOT THE LOD.

Appendix E

Calculating Non-standard Shift and Sequential Sample 8-hour TWAs

TWAs based on other time periods, e.g., 6 or 10-hour TWAs, must be recalculated as the 8-hour TWA.

When the 8-hour TWA is calculated from sequential samples in the same work shift, each sample receives a separate record and the calculated 8-hour TWA is recorded next to each actual value used to calculate that 8-hour TWA.

When calculating an 8-hour TWA from sequential samples in the same work shift that are a mix of results that are greater than and less than the LOQ, substitute $0.5 \times \text{LOQ}$ for values less than the LOQ. The calculated 8-hour TWA will be above the LOQ. For example, with two results above the LOQ and one less than the LOQ:

$$\frac{(\text{Value}_1 \times \text{Time}_{V1}) + (\text{Value}_2 \times \text{Time}_{V2}) + (\text{LOQ}_1 \times 0.5 \times \text{Time}_{\text{LOQ1}})}{480 \text{ minutes}} = 8\text{-hour TWA}$$

For example, assume a worker's exposure was unmeasured for 15 minutes at the beginning of the shift while donning clean work clothing and for 30 minutes at the end of a shift while showering and donning street clothes. Also assume that the worker was monitored for a 225 minute period with a result of $0.1 \mu\text{g}/\text{m}^3$ and for a 210 minute period with a result of less than the LOQ of $0.03 \mu\text{g}/\text{m}^3$. If the unmeasured periods are judged to have no potential for beryllium exposure, the 8-hour TWA would be:

$$\frac{(0.1 \times 225) + (0.03 \times 0.5 \times 210)}{480} = 0.053 \mu\text{g}/\text{m}^3$$

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